NCDOT

Environmental Services, Inc.

GAI Consultants, Inc.

Archaeological Predictive Modeling Project at The North Carolina Department of Transportation

2005 NC GIS Conference

Matt Wilkerson and Brian Overton

March 4, 2005

PROJECT GOALS (Long-Term)

- Digitize cultural information for the 3 physiographic provinces of North Carolina.
- Update and convert all existing OSA site files to MS Access database. Digitize all site and survey area data into GIS.
- Develop GIS archaeological predictive models.
- Create WWW-compatible GIS application for NCDOT and OSA Staff Use.
- Apply GIS archaeological predictive models to multiple corridor transportation projects (aid in preferred selection through alternatives analysis).

PROJECT STRUCTURE

Task 1

- Update archaeological database to help in the modeling process.
- Collect and convert historic and prehistoric data for the initial pilot study area.
- Collect environmental GIS data to help in the modeling process.

Task 2

- Develop GIS Prehistoric Archaeological Predictive Models for the pilot study area.
- Create WWW-compatible GIS application for for NCDOT and OSA Staff Use.

Future Tasks

- Continue process across North Carolina.

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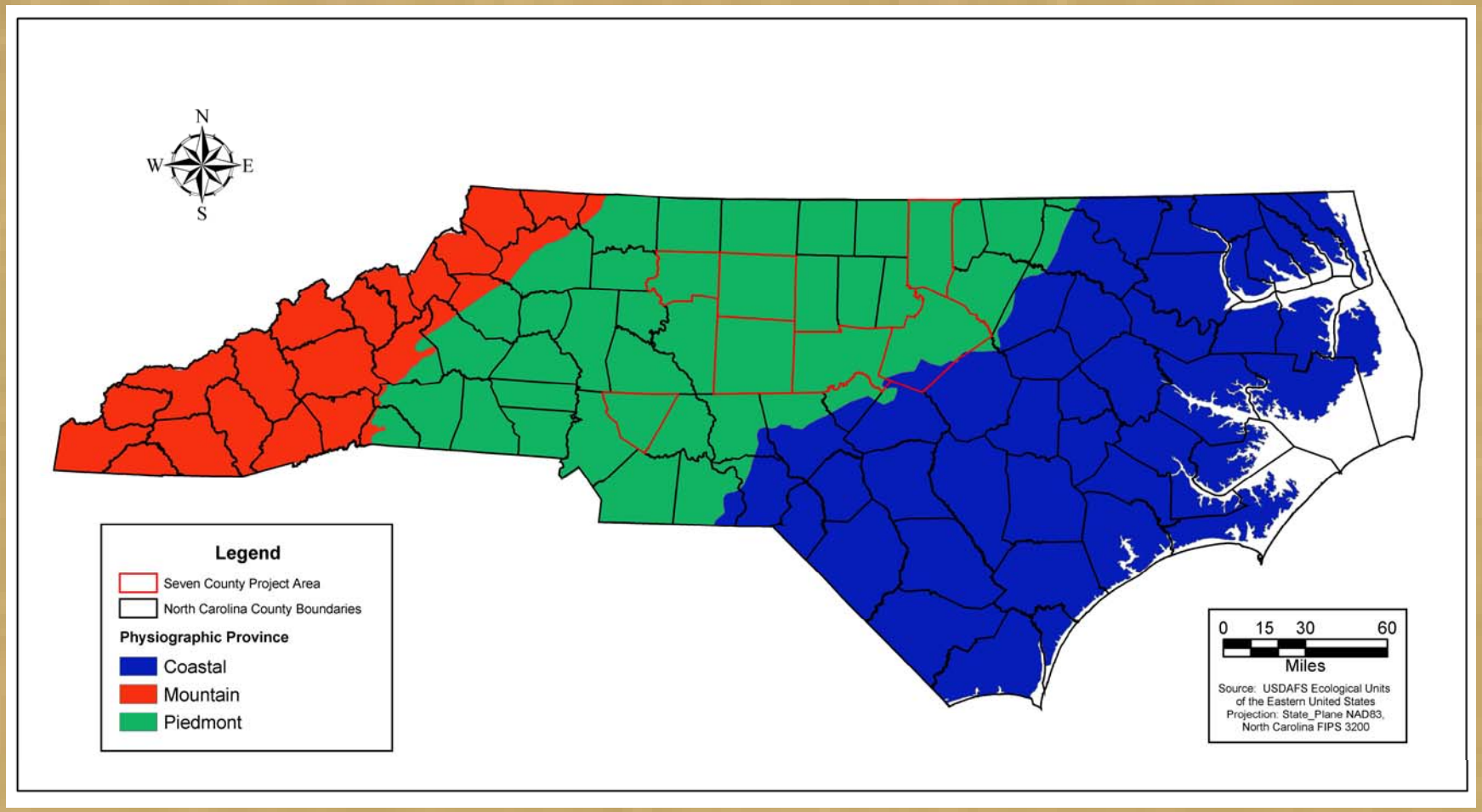
Current Project Area



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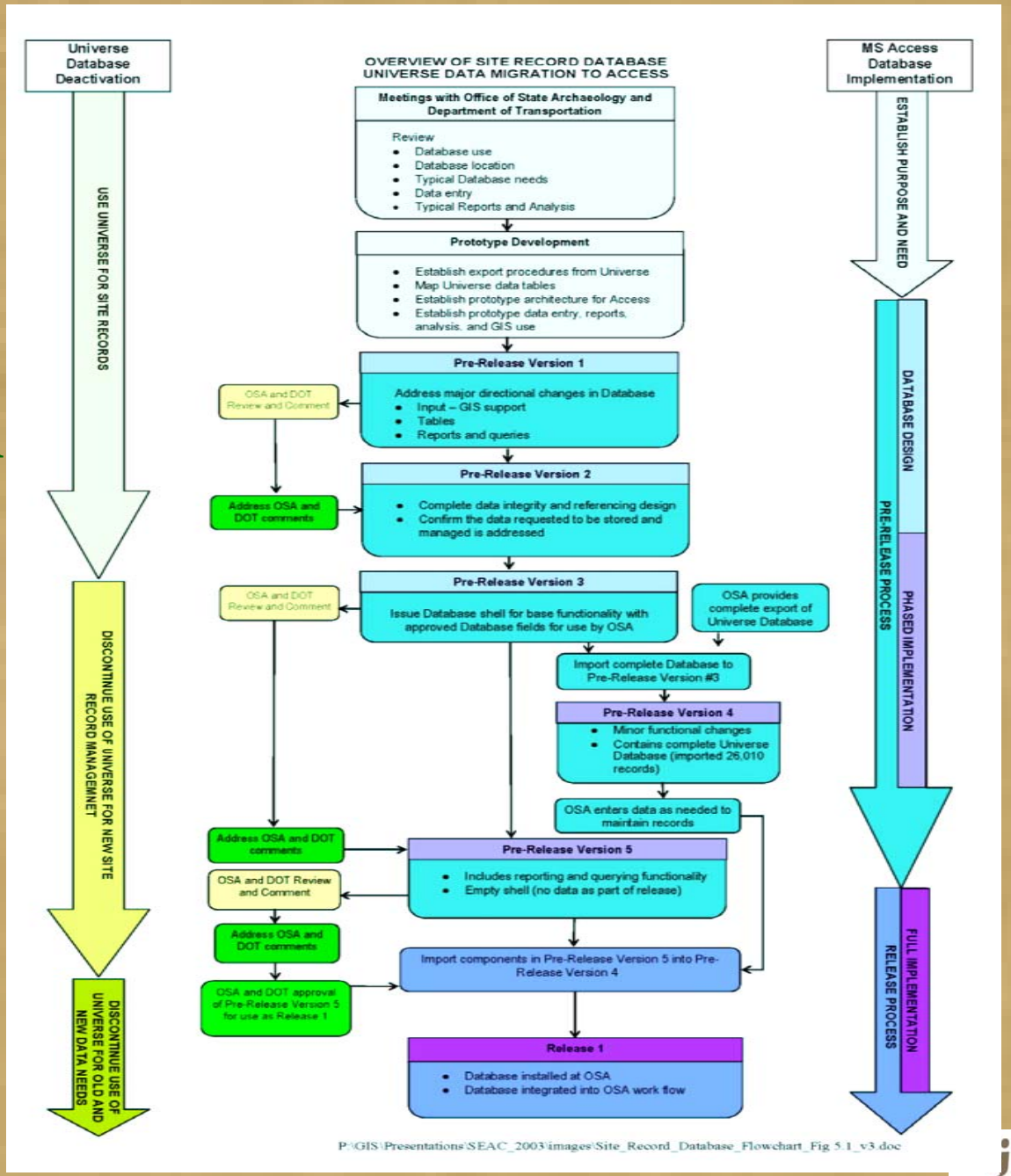
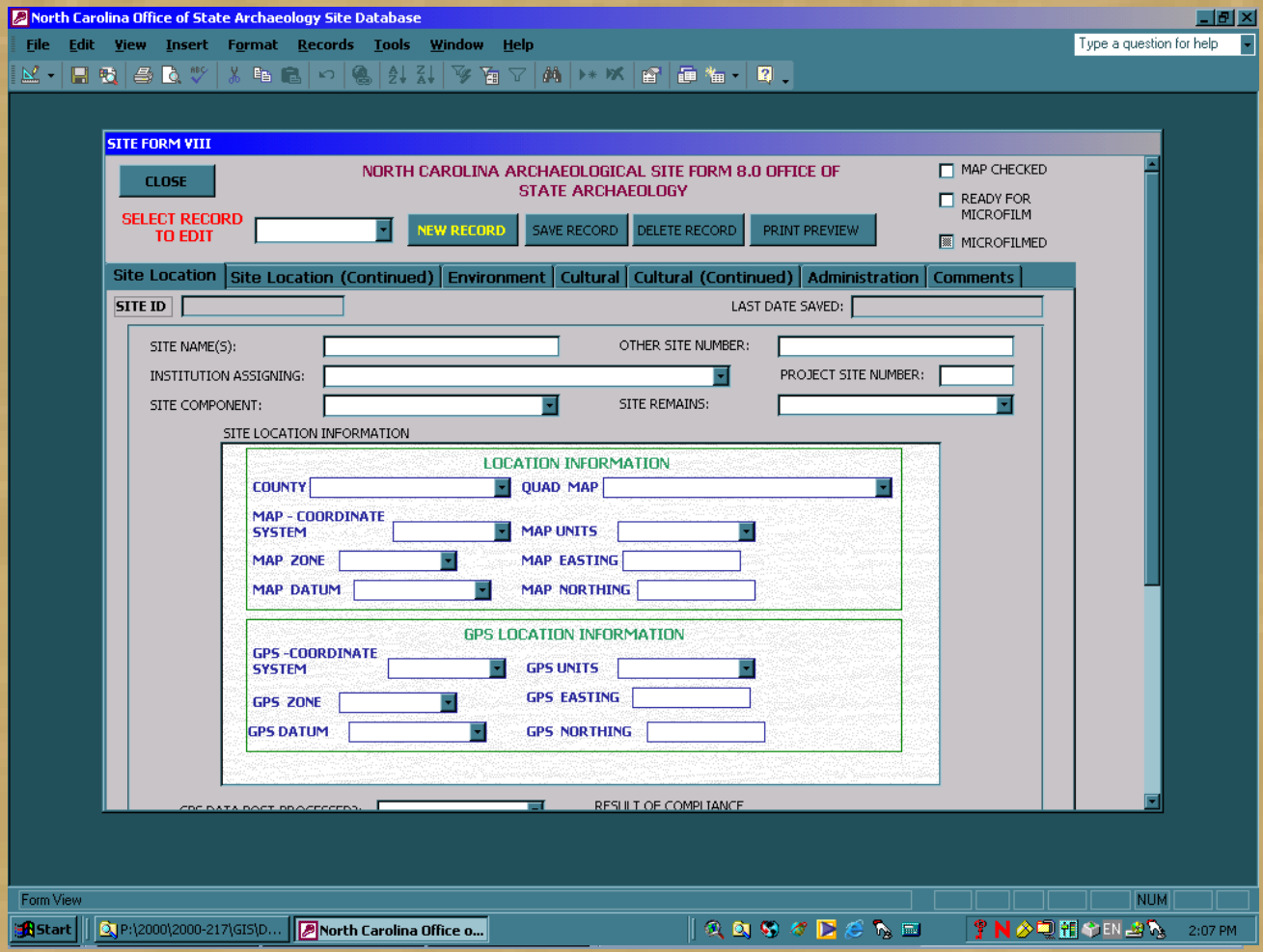
Database Migration Plan



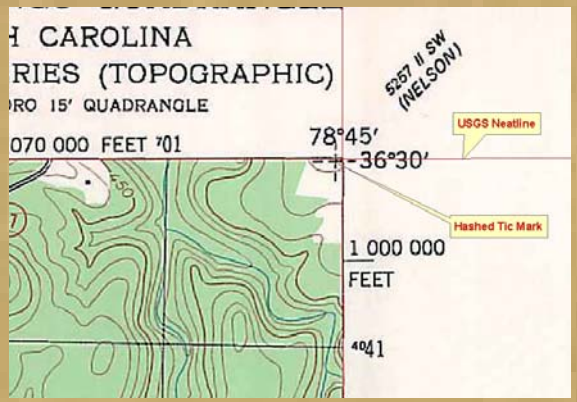
Database



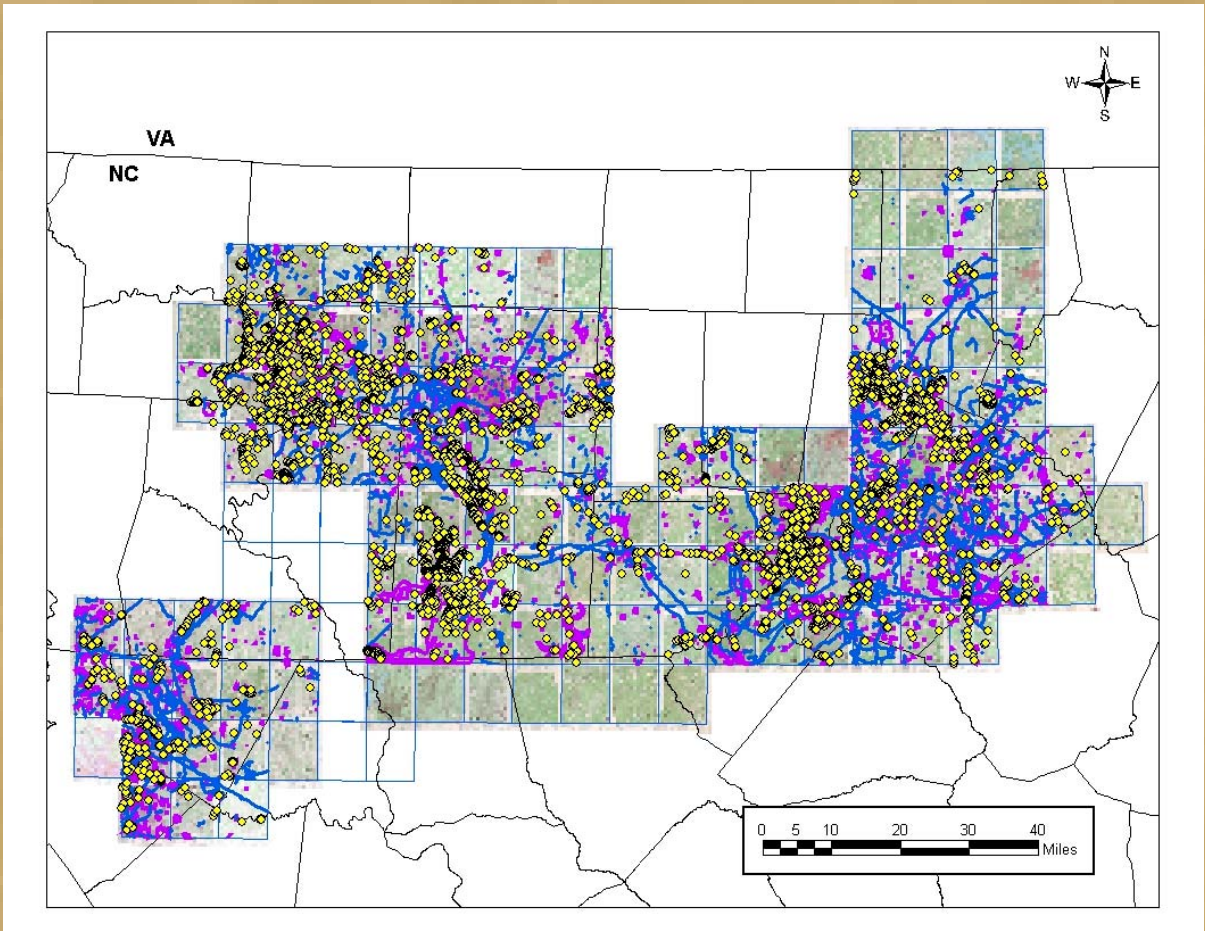
- 26,000 Records in UniVerse Database
- 30 Parent Tables
- 52 Lookup Tables

Digitization Process

Scanning → Georeferencing → Feature Extraction



Feature Extraction Results



- 7,103 Polygons
- 5,179 Points
- 2,184 Lines
- 14,466 Features Total

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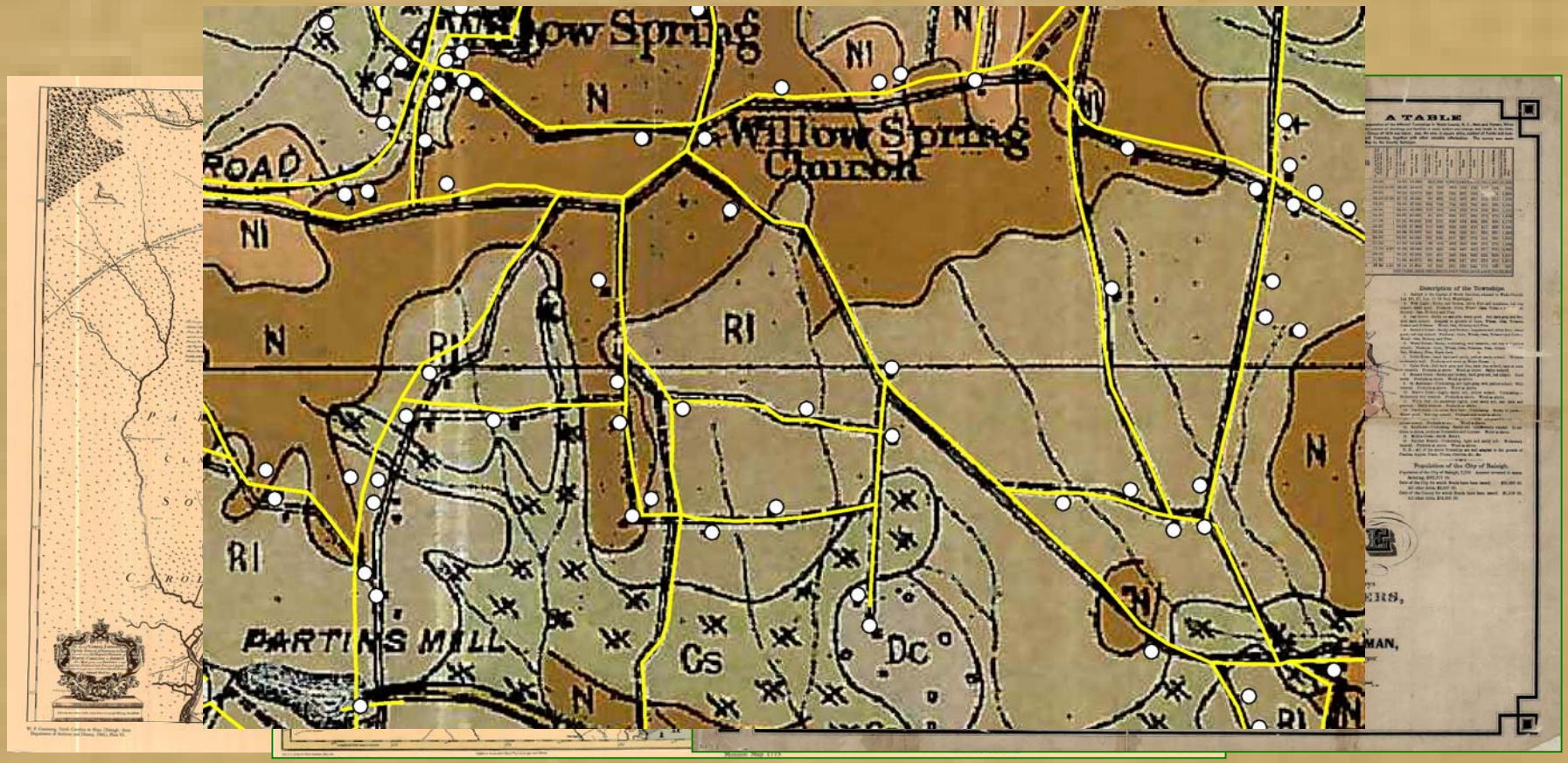
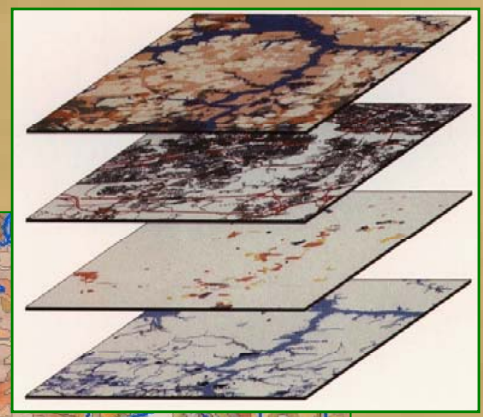
Historic Maps

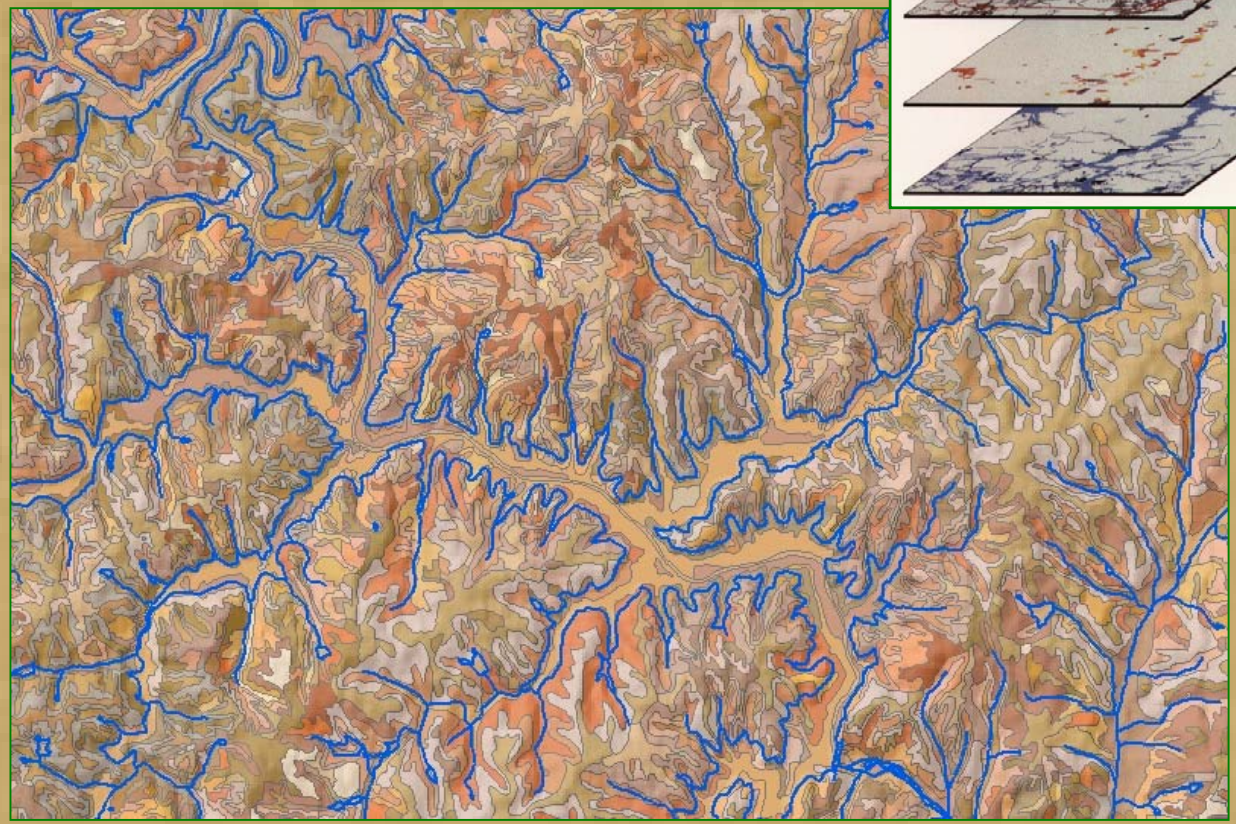


- Scanned 421 Historic Maps
- Digitized 20th Century Soils Maps (7), 19th Century County Maps (2), and Statewide Maps (2)

Collection of GIS Data for the Model

- NCDOT, CGIA, and various Federal, State, and local sources were reviewed
- A total of 372 data layers acquired, reviewed, and catalogued





(SSURGO digital soils and vector hydrology)

Task 2 Work (In Progress)

3 Main Objectives:

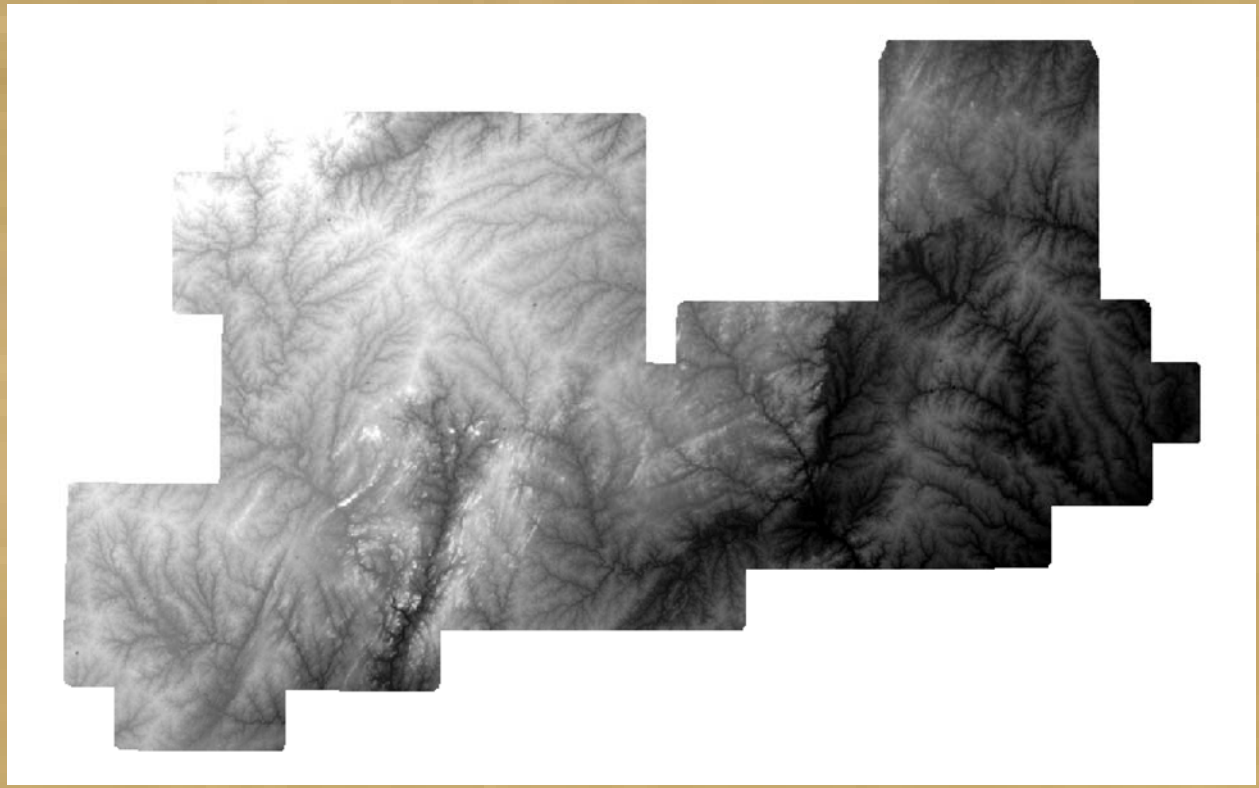
- Prehistoric Archaeological Site Predictive Modeling
- Decision Support Mechanism (WWW-based GIS Application)
- Further alterations to the OSA Site Form Database

Variables Considered for Modeling (Literature Review)

- Elevation
- Slope
- Aspect
- Aspect N/S
- Aspect E/W
- Solar Radiation
- Distance to Water
- Vertical Distance to Water
- Cost Distance to Water
- Distance to Confluences
- Cost Distance to Confluences
- Topographic Variation
- Soils
- Landuse Variables

ENVIRONMENTAL VARIABLES ANALYZED

- **Elevation**
- Aspect Variables
- Cost-Distance to Water Variables
- Cost-Distance to Confluences Variables
- Distance to Confluence Variables
- Distance to Water Variables
- Slope
- Solar Radiation
- Topographic Variation Variables



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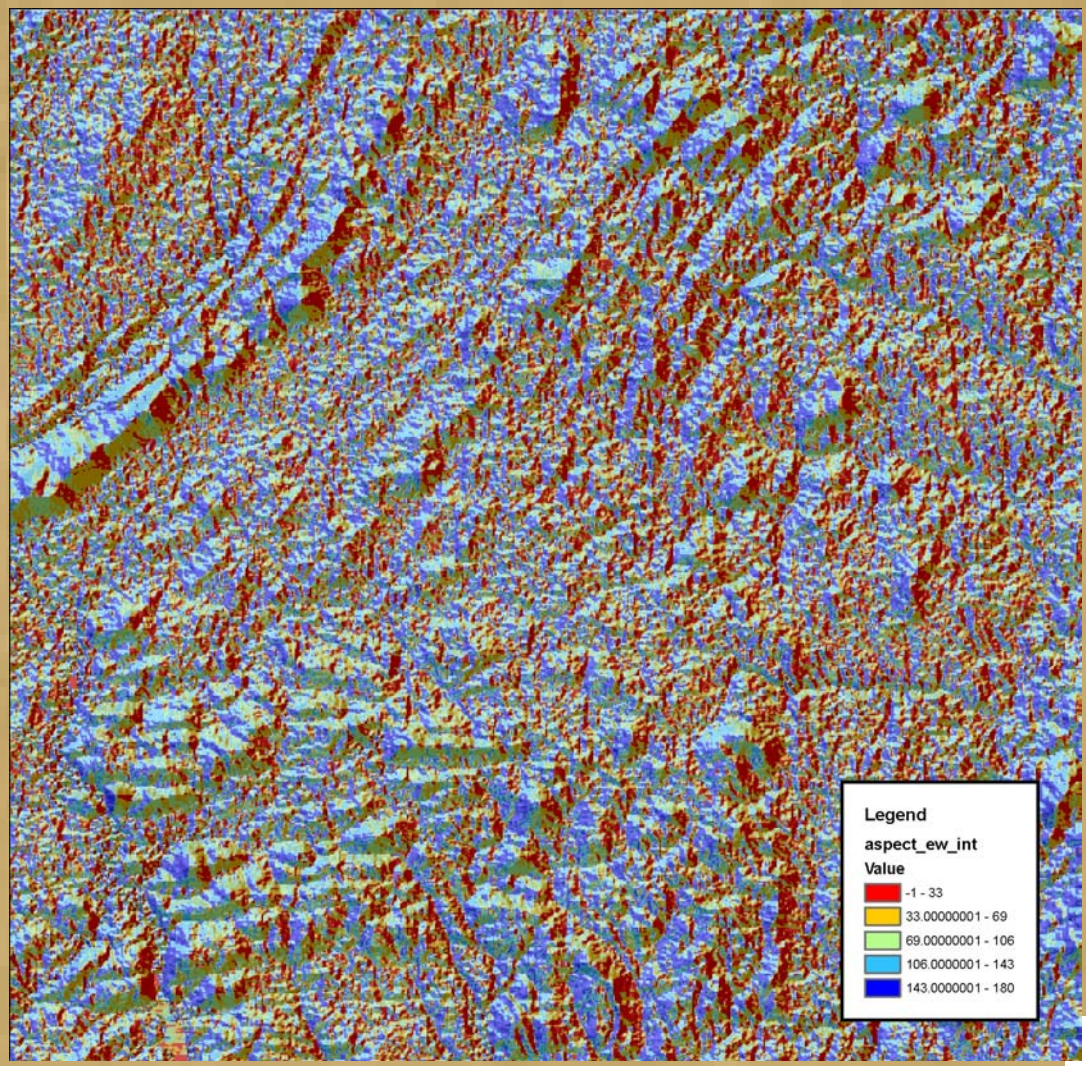

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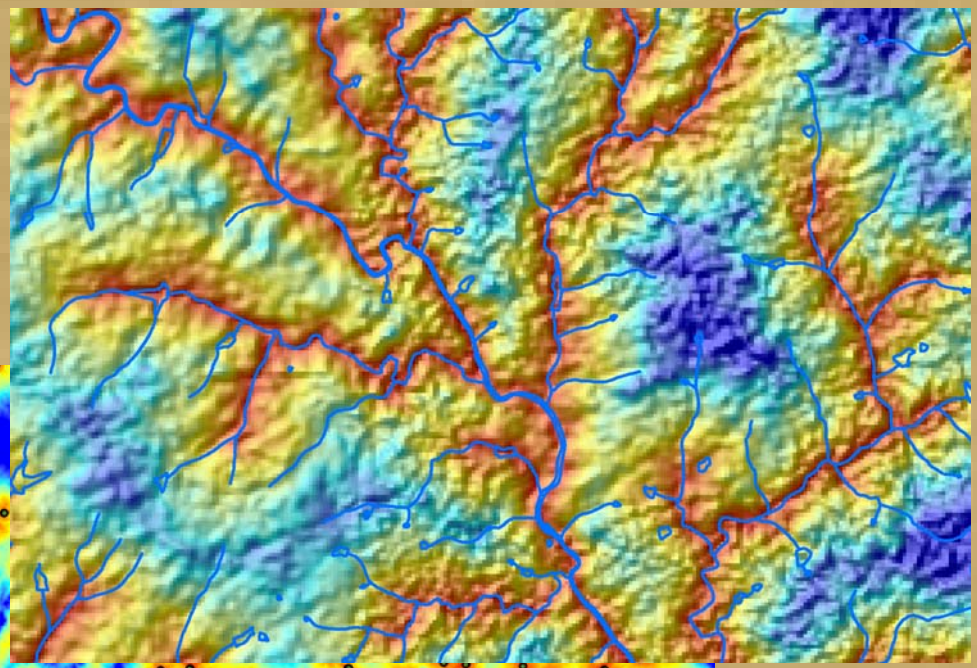

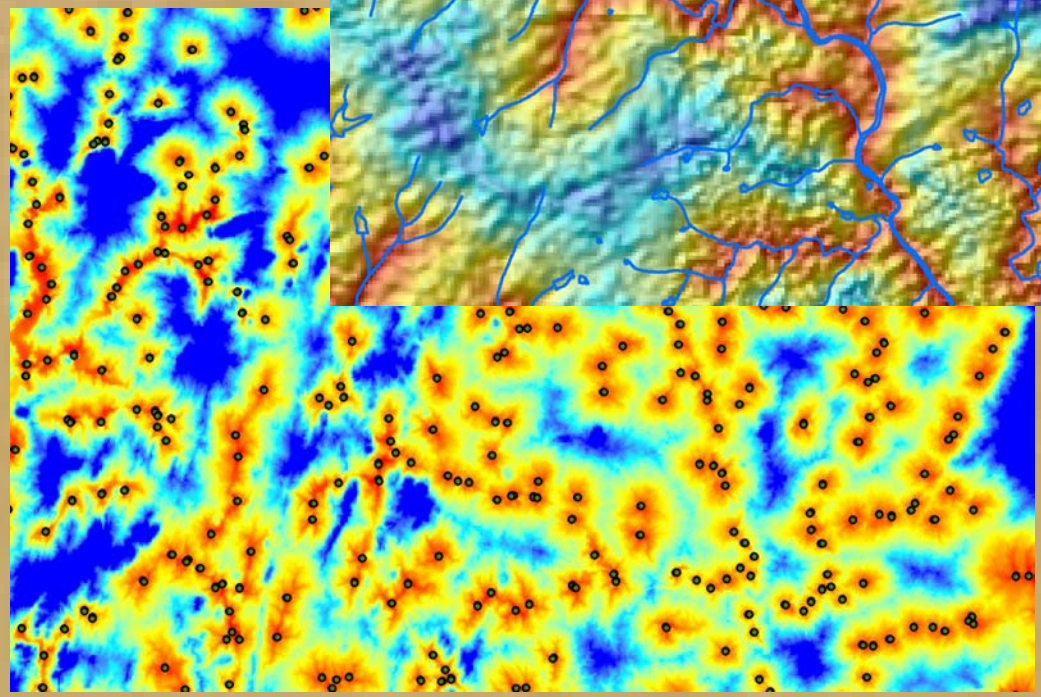

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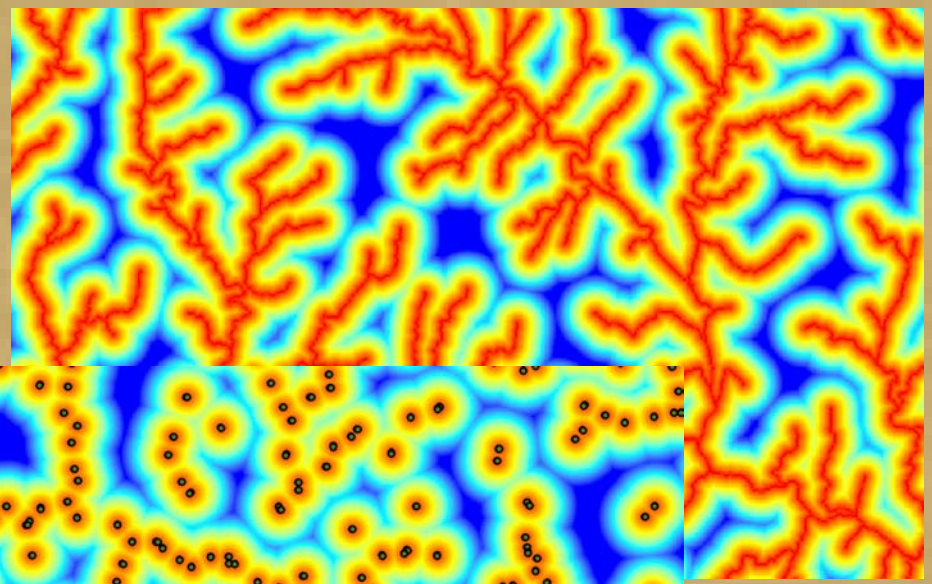

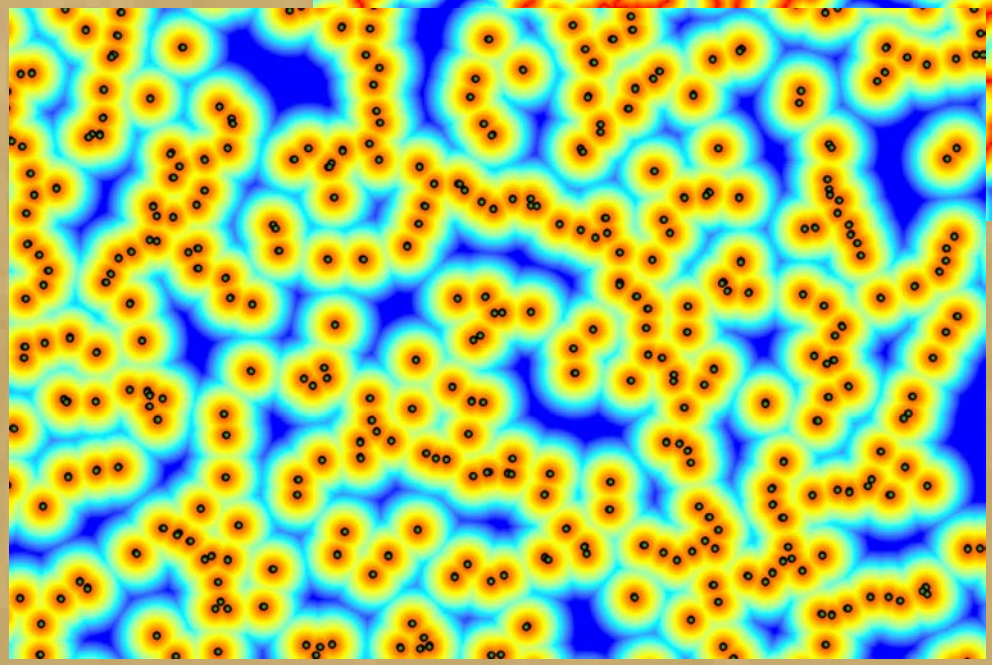

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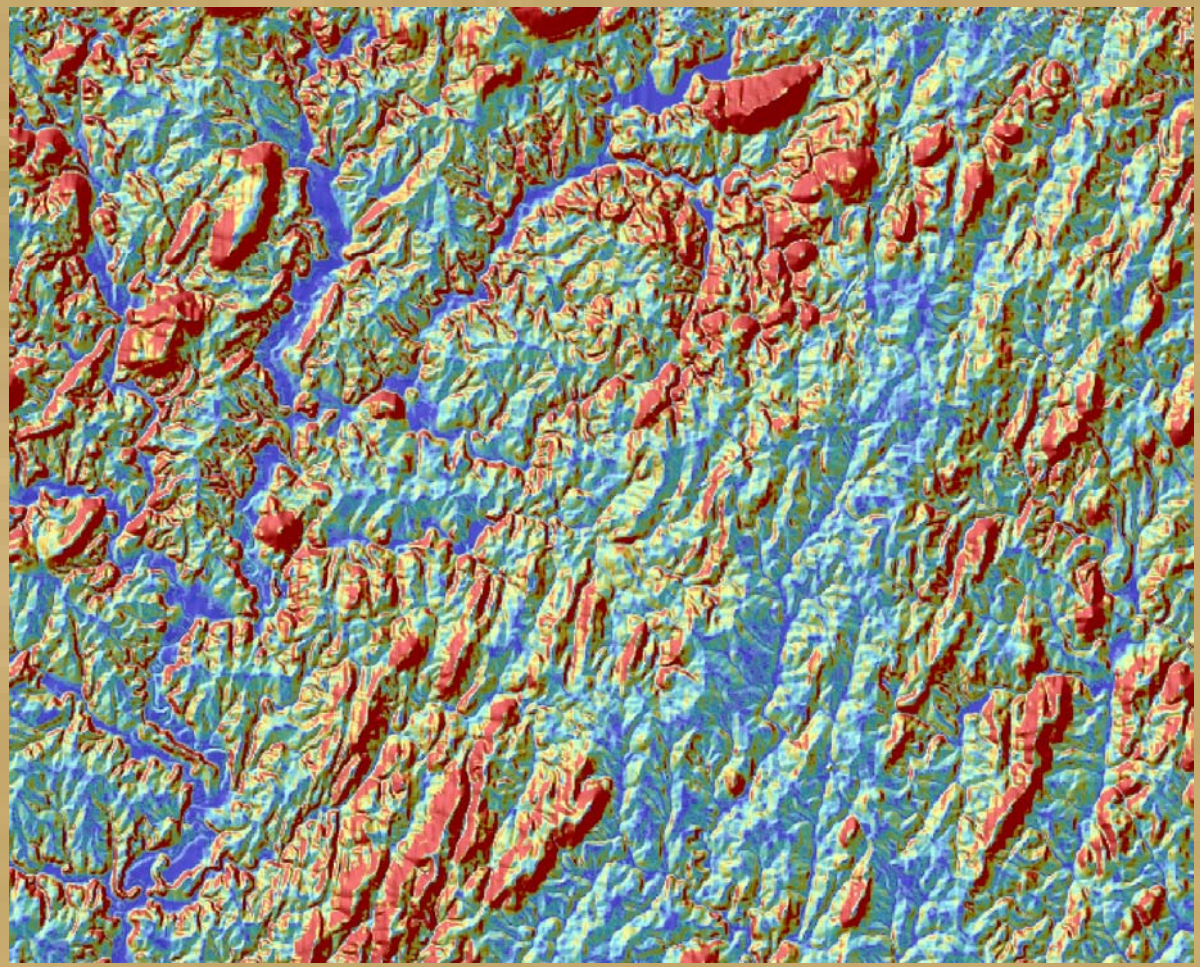
- Topographic Variation Variables



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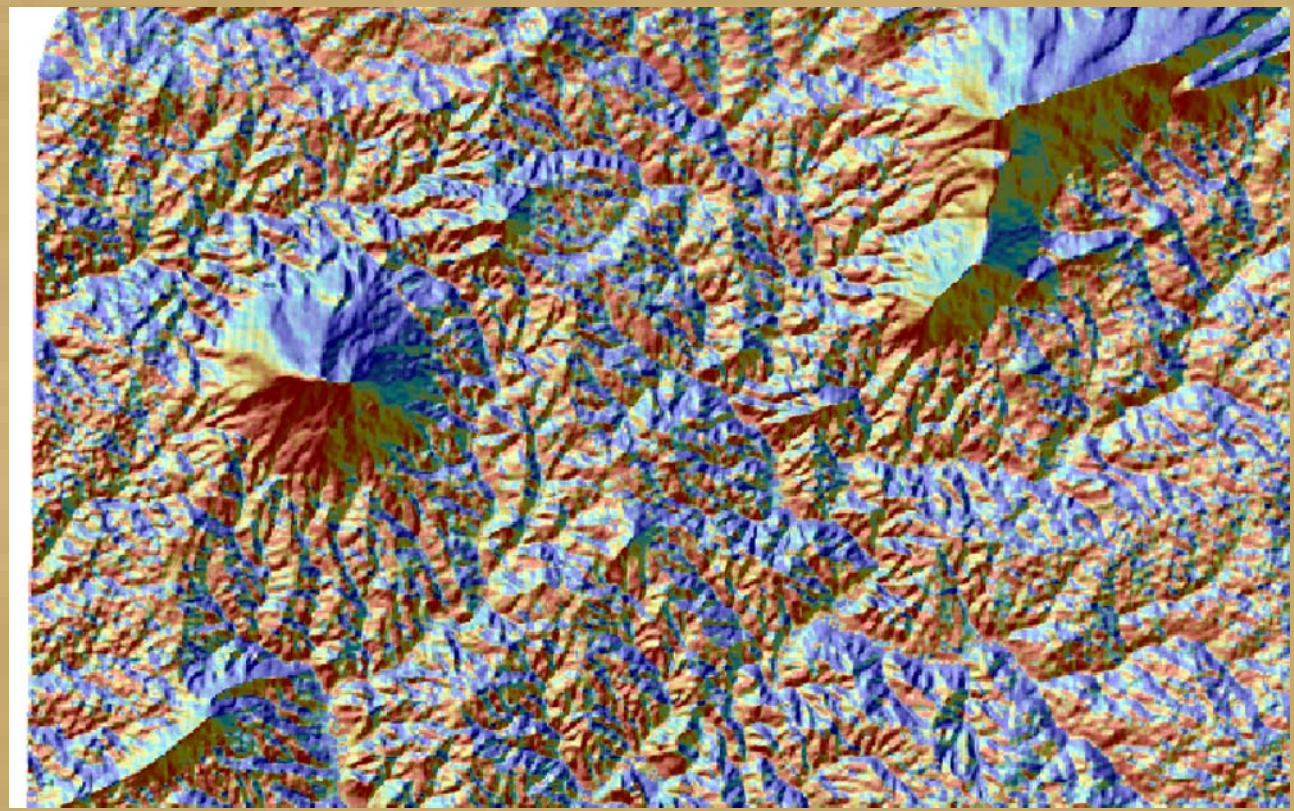

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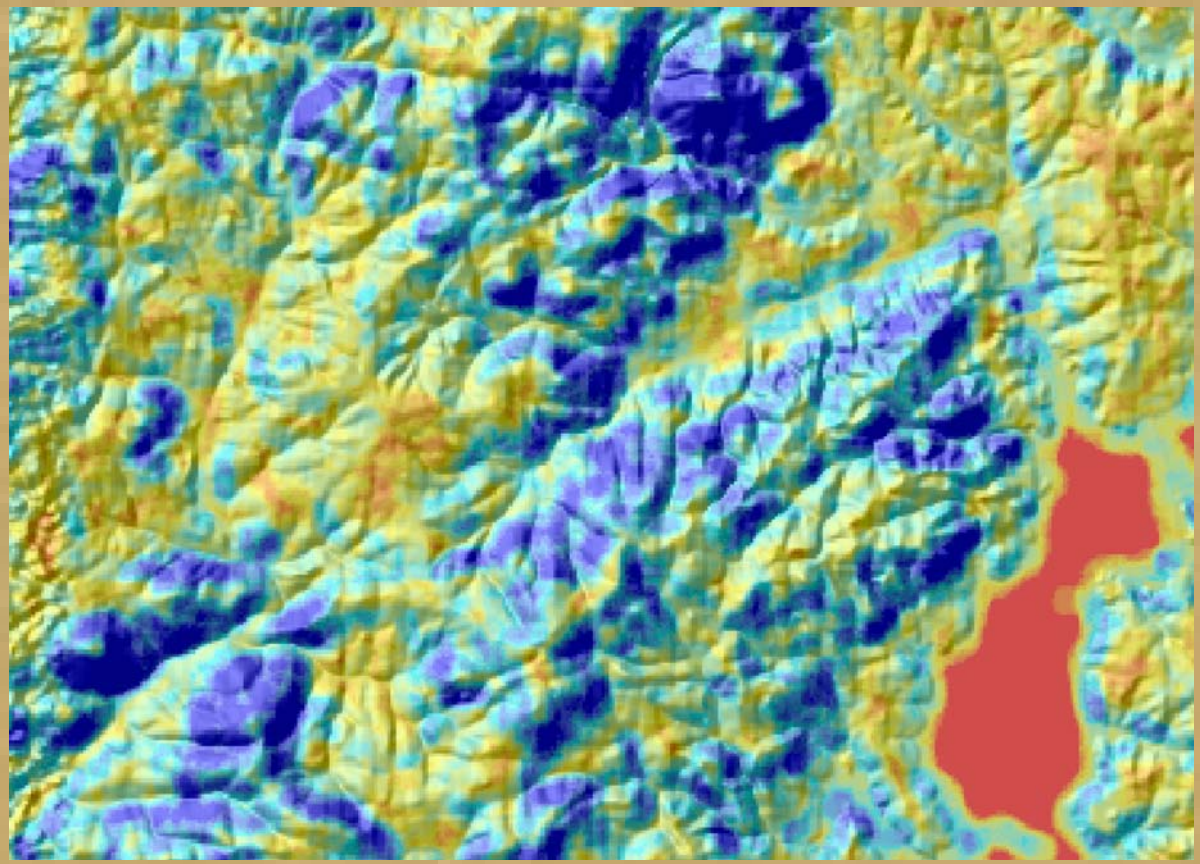
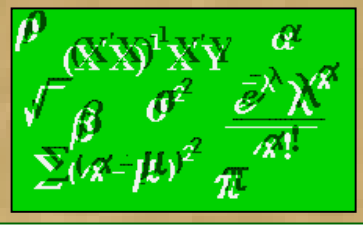
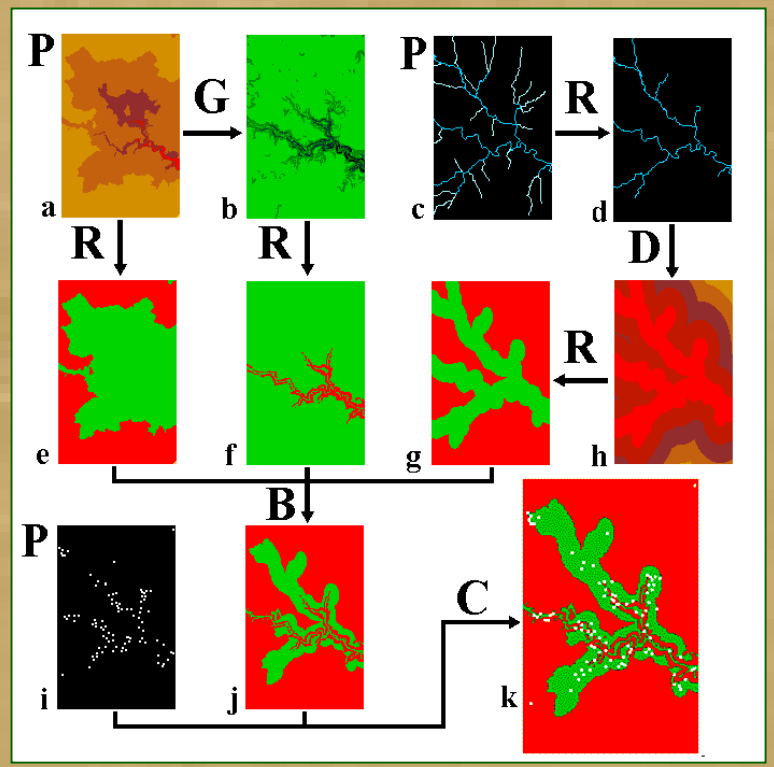


MODEL DEVELOPMENT

- Coordinated with Ken Kvamme (U. Arkansas)
- Spatial Statistics of sites and different variables
- Logistic Regression
- GIS Analysis
- Creation of Initial Model of High/Medium/Low Site Probability



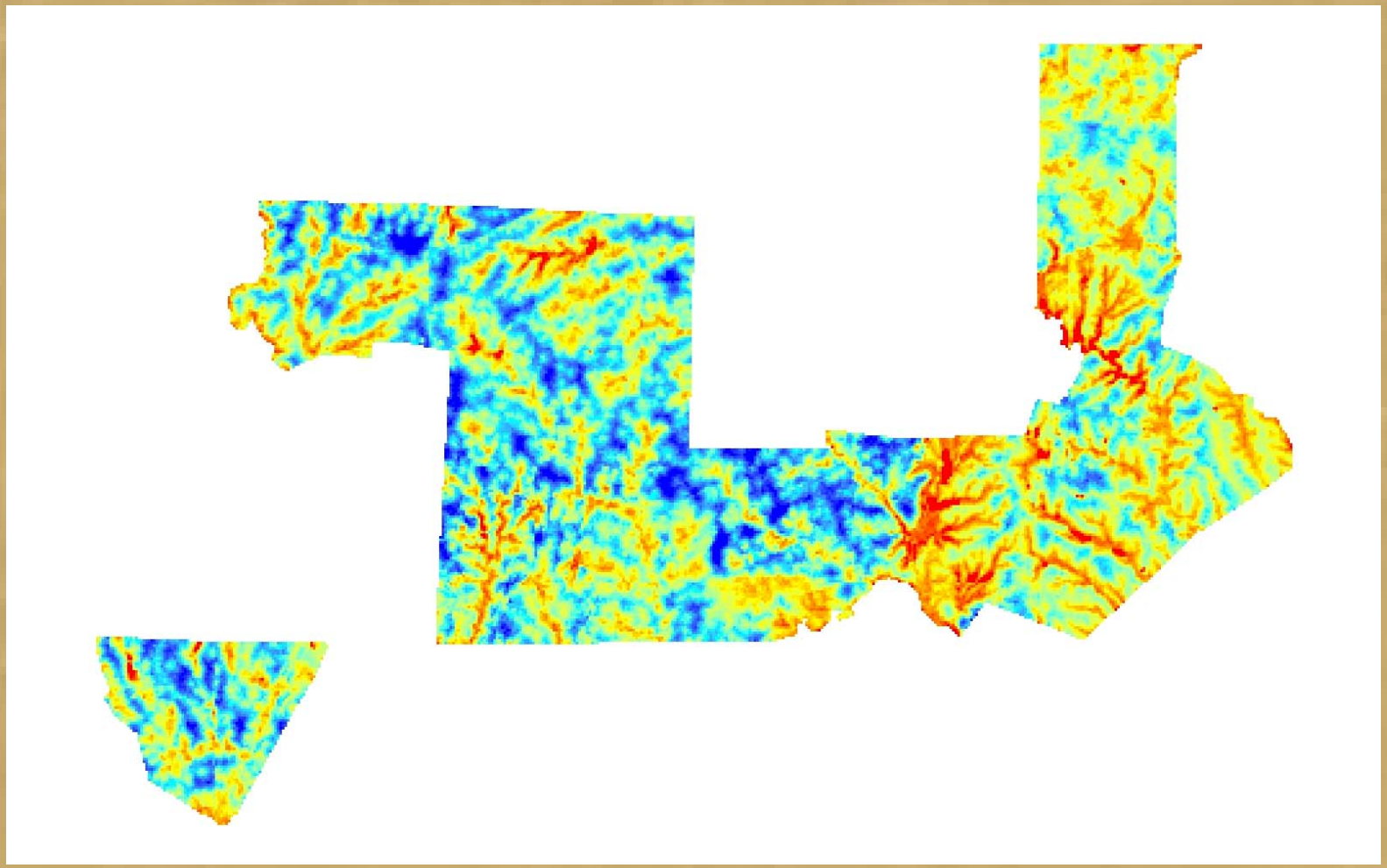


ELIMINATING REDUNDANT AND USELESS VARIABLES

Using a combination of Pearson's Correlation and the K-S Test, we eliminated variables that provided redundant information or would not add to the predictive model.

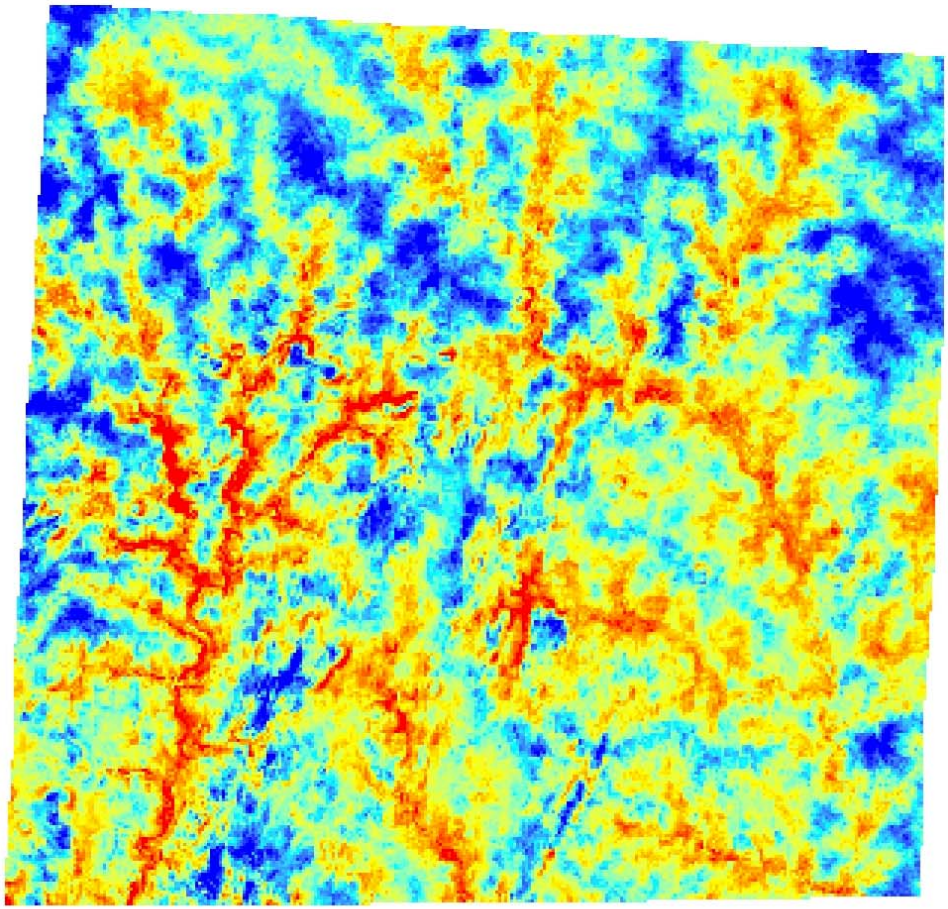
- ***Aspect East/West***
- ***Aspect North/South***
- ***Cost Distance to Water 100***
- ***Cost Distance to Water 1000***
- ***Cost Distance to Water 10000***
- ***Cost Distance to Confluence 1000***
- ***Cost Distance to Confluence 10000***
- ***Distance to Stream Confluence 500***
- ***Elevation (NED)***
- ***Slope (NED)***
- ***Topographic Variation***

7-COUNTY MODEL



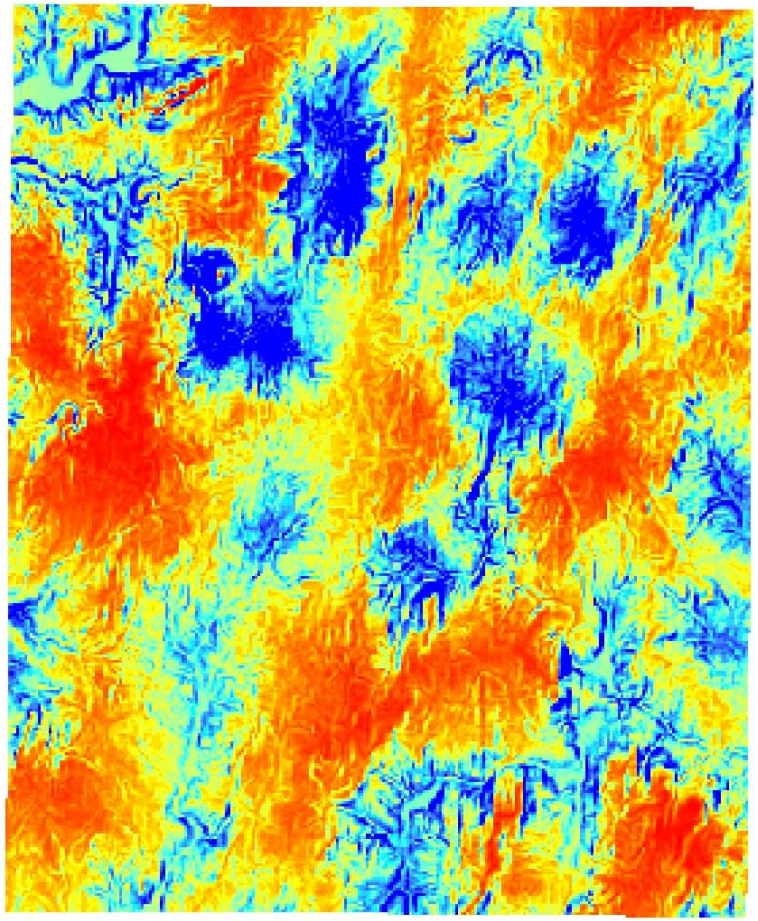
Variables Include: Aspect NS, Cost-Distance to Water_100, Cost Distance to Confluence 1000 and 10000, Slope, and Topographic Variation.

RANDOLPH COUNTY MODEL



Variables Include: Cost-Distance to Water_100 and 10000, Cost Distance to Confluence 1000 and 10000, Slope, and Topographic Variation.

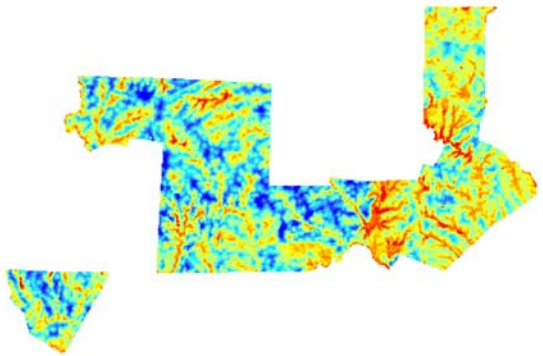
ASHEBORO QUAD MODEL



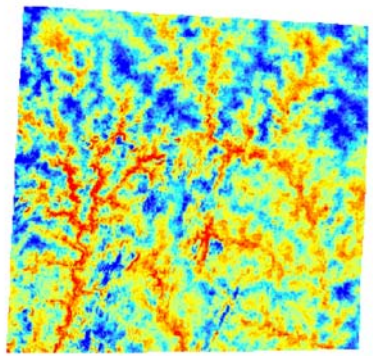
Variables Include: Cost-Distance to Water_1000, Cost Distance to Confluence 1000, and $\bar{S}$lope.

QUESTIONS OF MODEL SCALE AND PRECISION

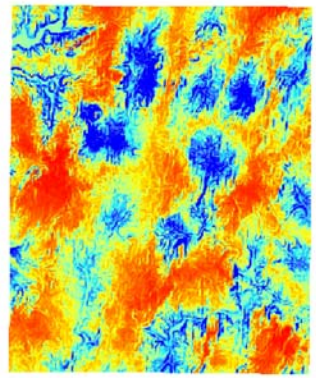
- One single model is consistent, but probably less robust
- County level models may be more locally precise but have edge effects
- Quad level models even more so with lower sample size?
- How to balance these?



7-county Model



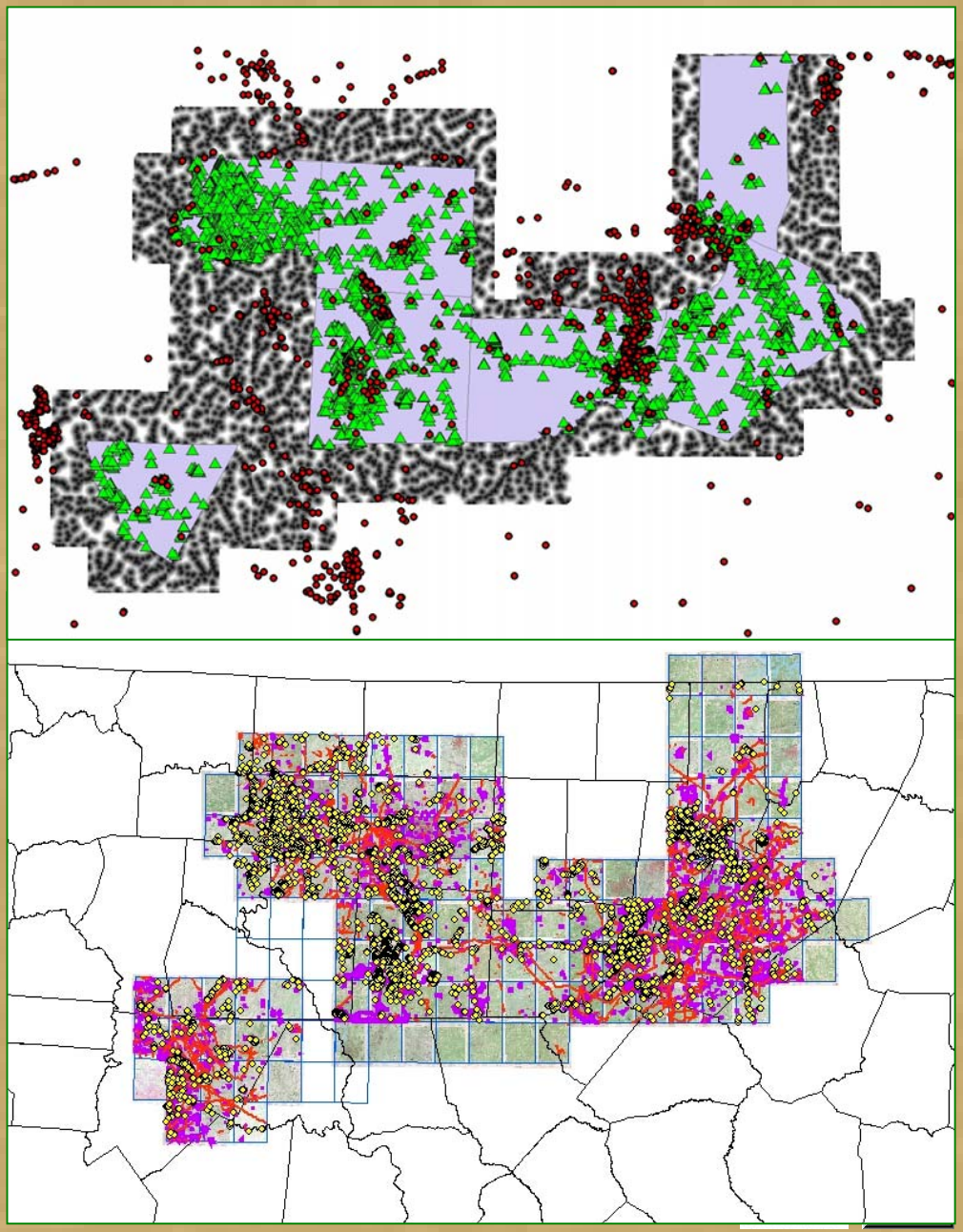
County Model



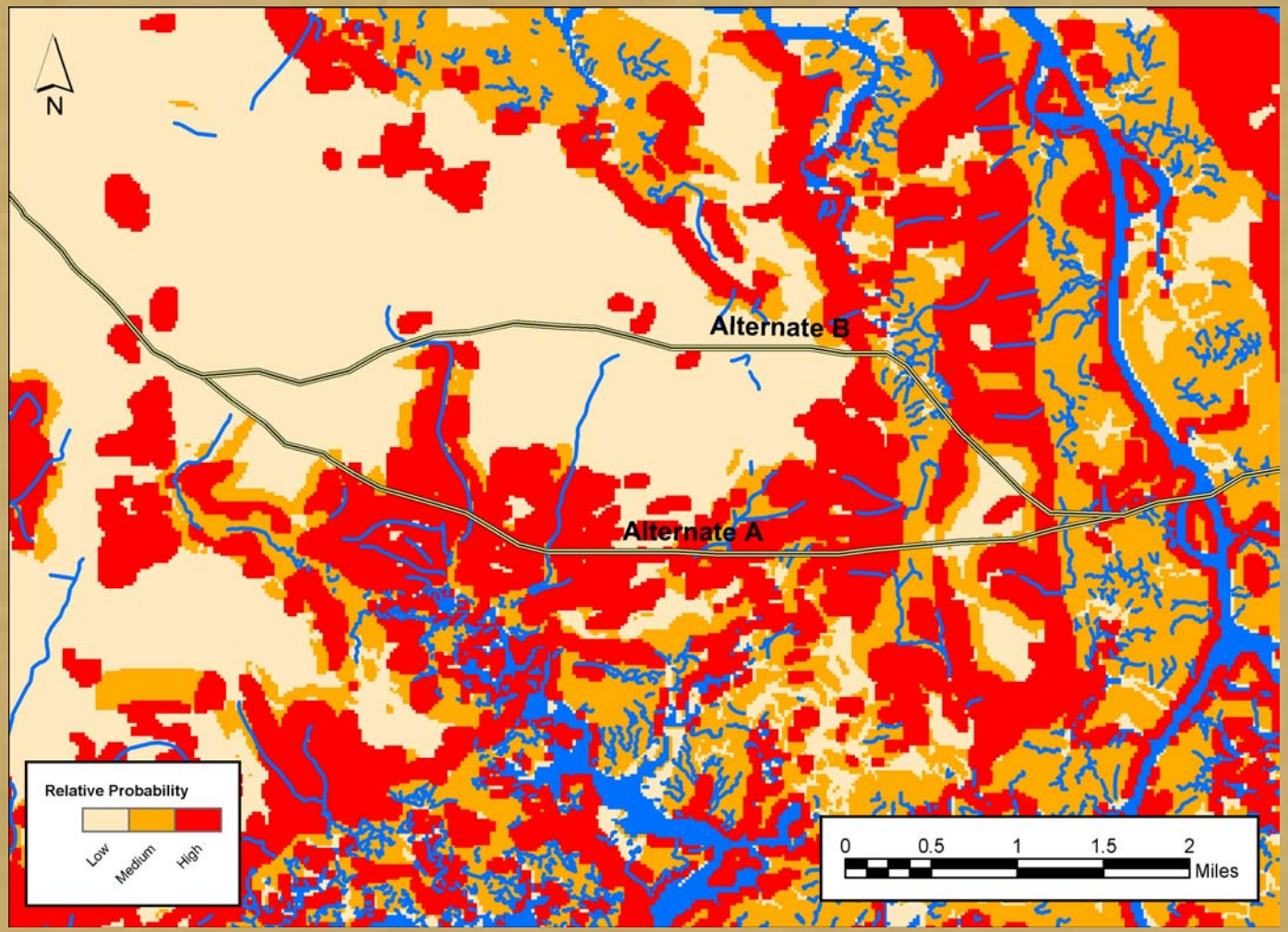
Quad Model

Testing and Validation

- Test and compare all models against:
  - 10% withheld sample (484 points)
  - UNC Diagnostic database
  - Sites on edges of quads that were digitized but not used in the analysis
  - Eventually test against field work on Asheboro bypass



Example of Model and Use



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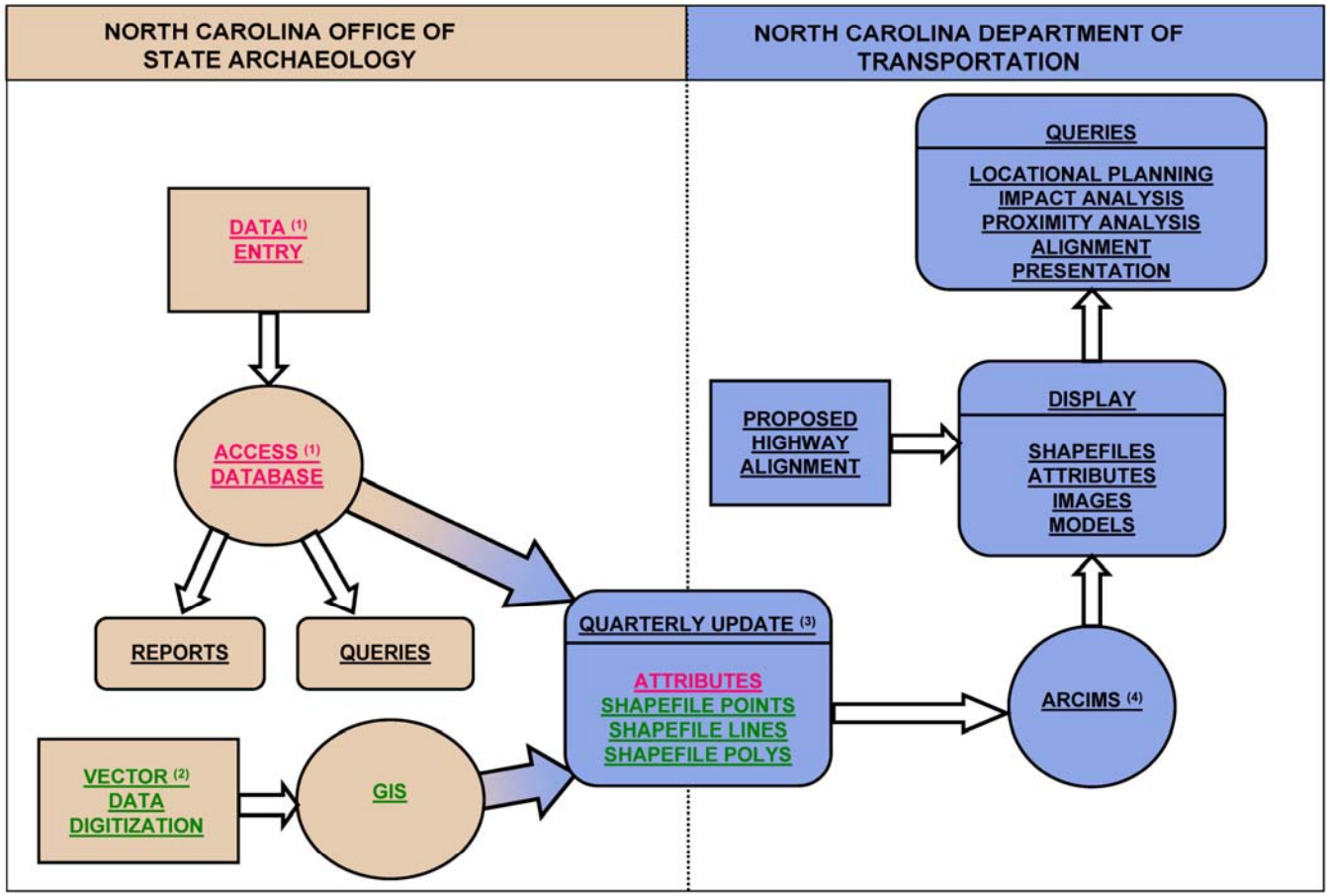
Decision Support Mechanism

FIGURE 1
DATA FLOW AND MODEL USE

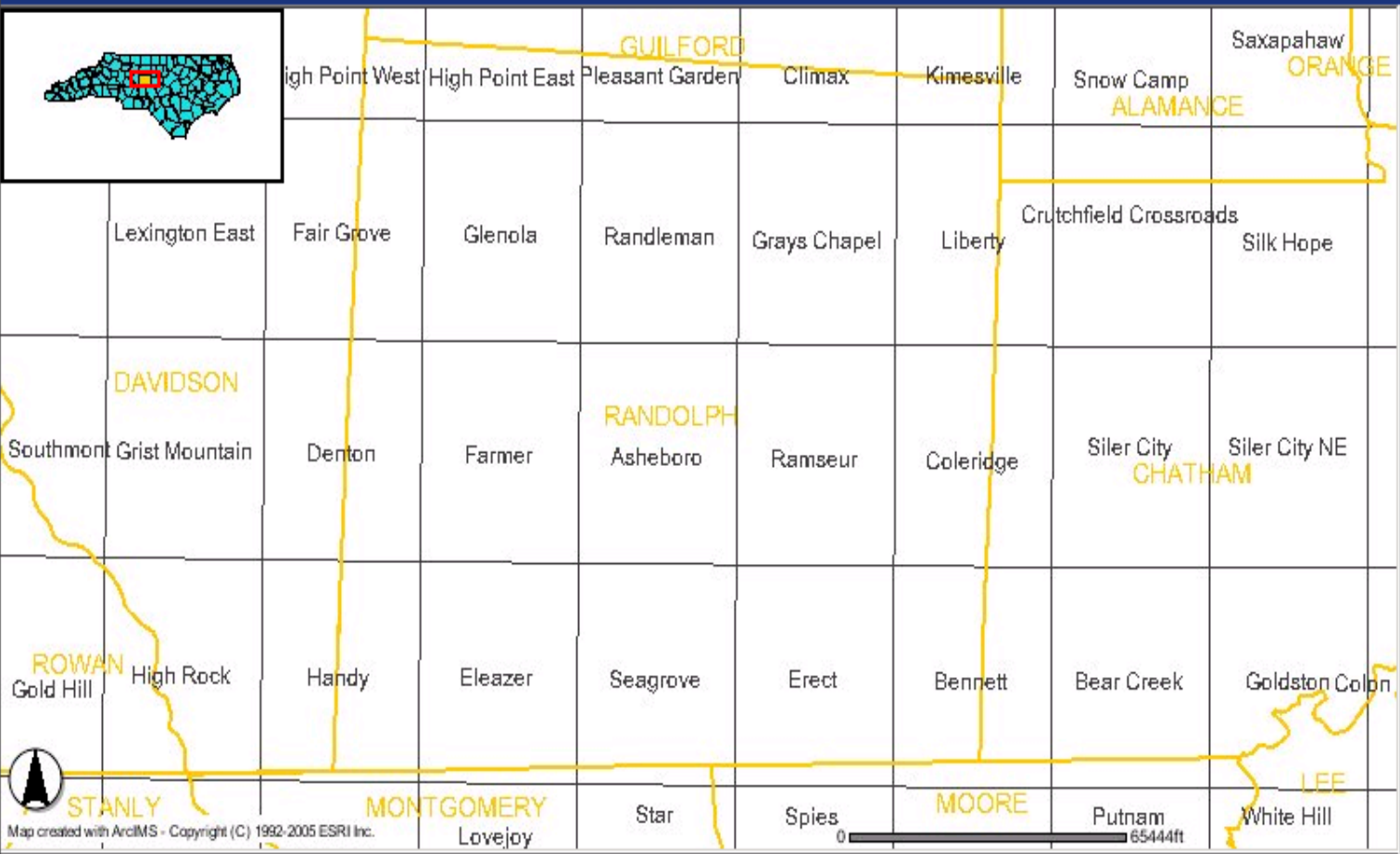


NOTES:
(1) DATA ENTRY AND ACCESS DATABASE TO BE MAINTAINED BY OSA
(2) VECTOR UPDATES GENERATED BY NCOSA
(3) QUARTERLY VECTOR DATA UPDATES BY NCOSA TO NCDOT. NCDOT TO UPLOAD UPDATED SHAPEFILES.
(4) ARCIMS SECURITY PROVIDED BY NCDOT. ARCIMS SITE TO RESIDE ON NCDOT SERVER

P:\2000\2000-217\TASK2

Links | Customize Links | Free Hotmail | Windows Media | Windows

NCDOT APM - Randolph County



LAYERS

- All Layers
  - DOT Alignment
  - Randolph Predictive Mod
  - Archaeological Points
  - Archaeological Sites
  - Projects Surveyed
  - Projects Reviewed
  - Other
  - County Boundaries
  - Quadrangle Boundaries
  - Streams/Hydrology
  - Aerial Photography
  - Topographical Mapping
  - Historic Soil 1913
  - OSA Quadrangle Maps

Refresh Map

Auto Refresh

Help:

- A closed group, click to open.
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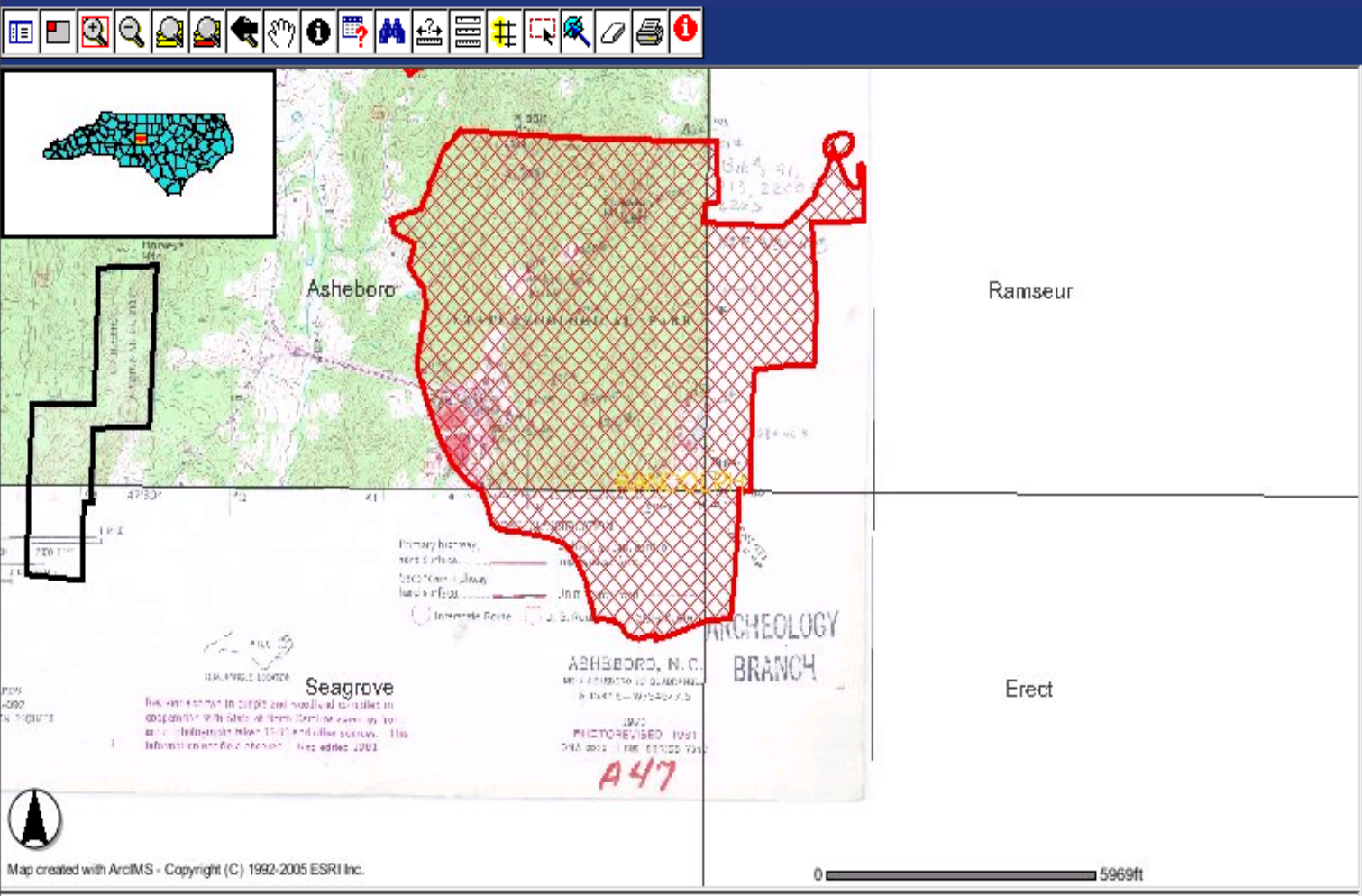
- A visible group/layer, click to hide.
- A visible layer, but not at this scale.
- A partially visible group, click to make visib

Zoom In

Map: 588174.71 , 207408.03 -- Image: 796 , 287 -- ScaleFactor: 124.67093678219922

Internet

NCDOT APM - Randolph County



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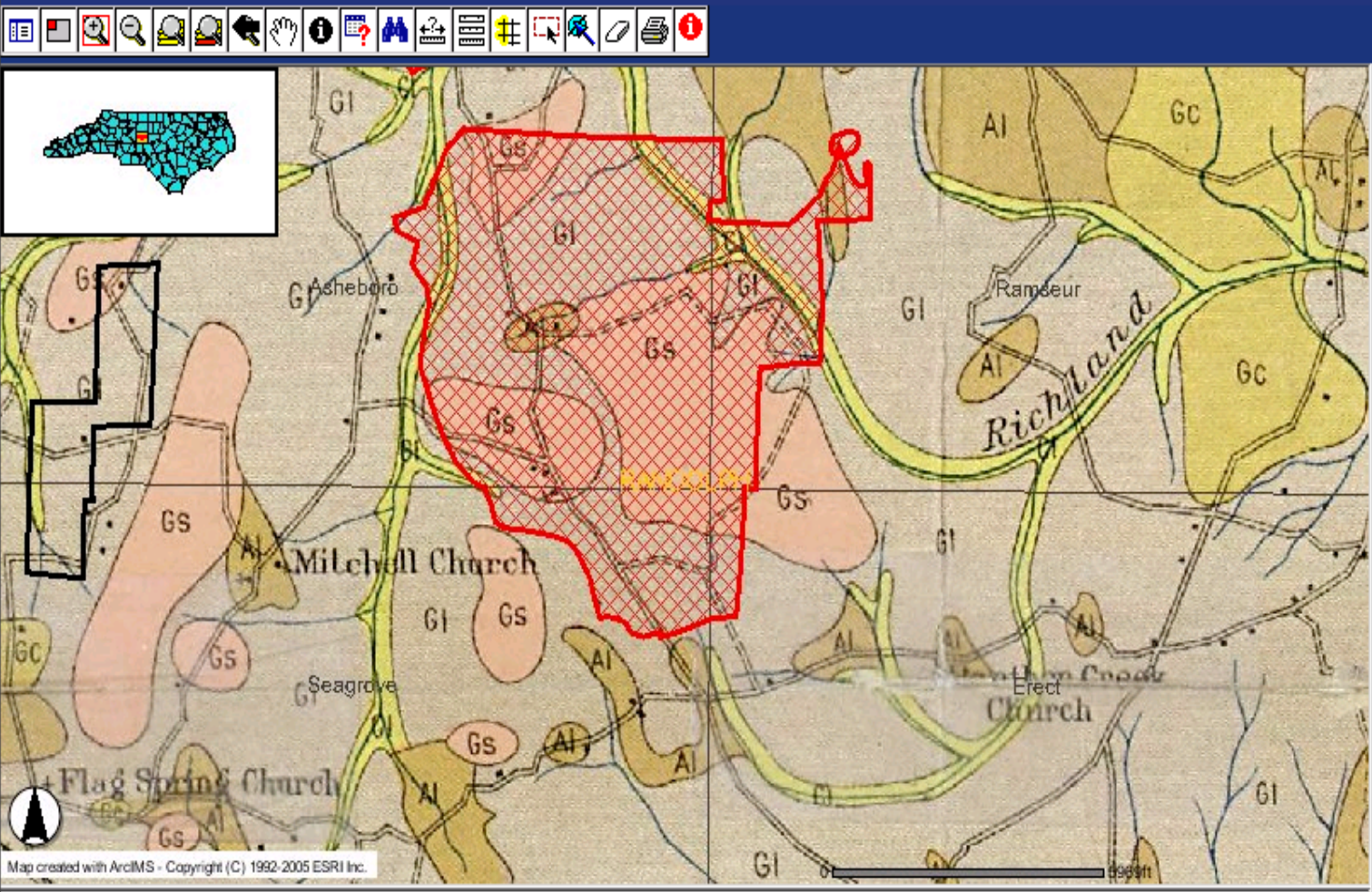
    - Eleazer-E30
    - Erect-E26
    - Fair Grove-F73
    - Farmer-F78
    - Glenola-G71
    - Grays Chapel-G47
    - Handy-H49
    - High Point East-H79
    - High Point West-H90

Zoom In

NCDOT APM - Randolph County



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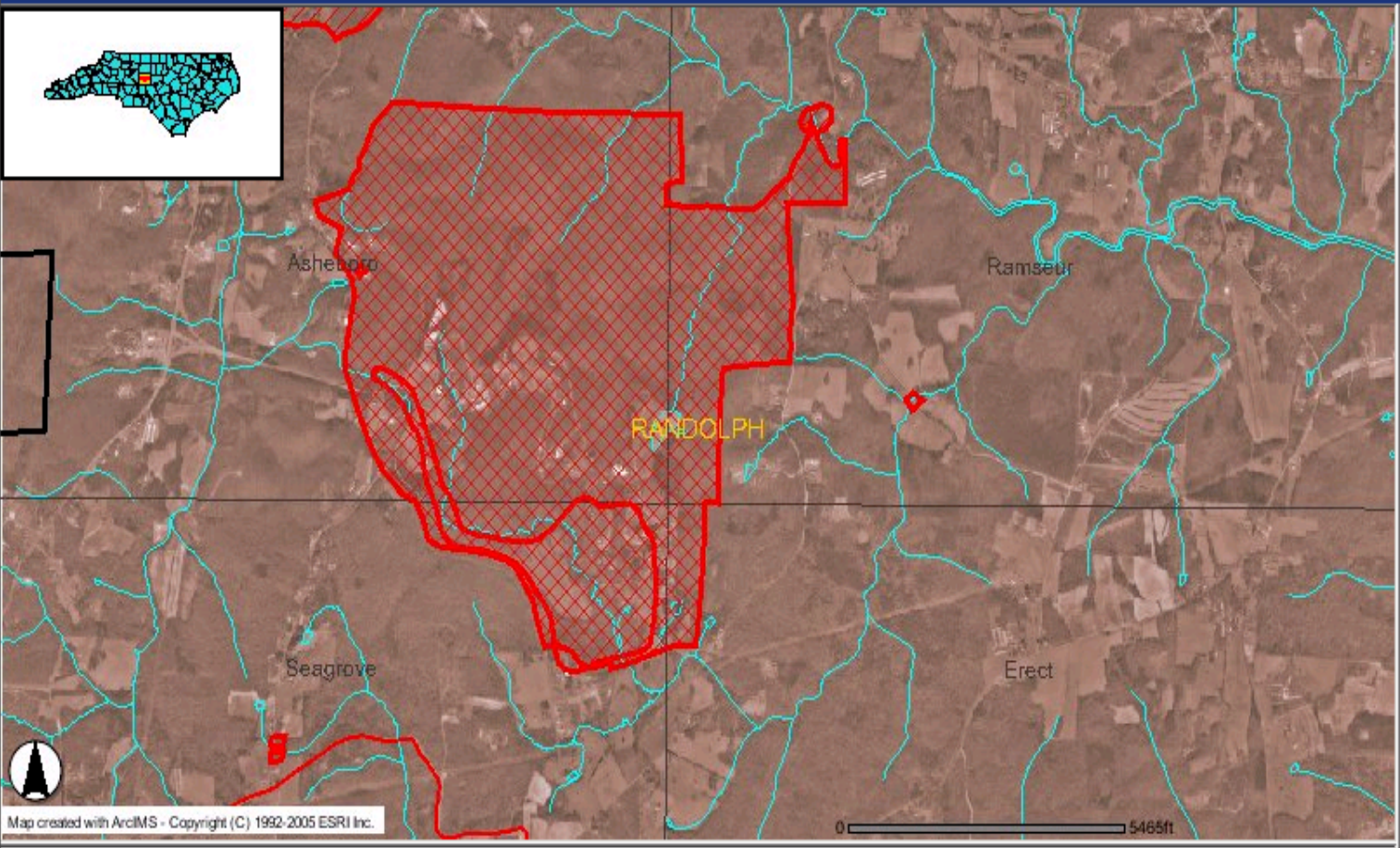

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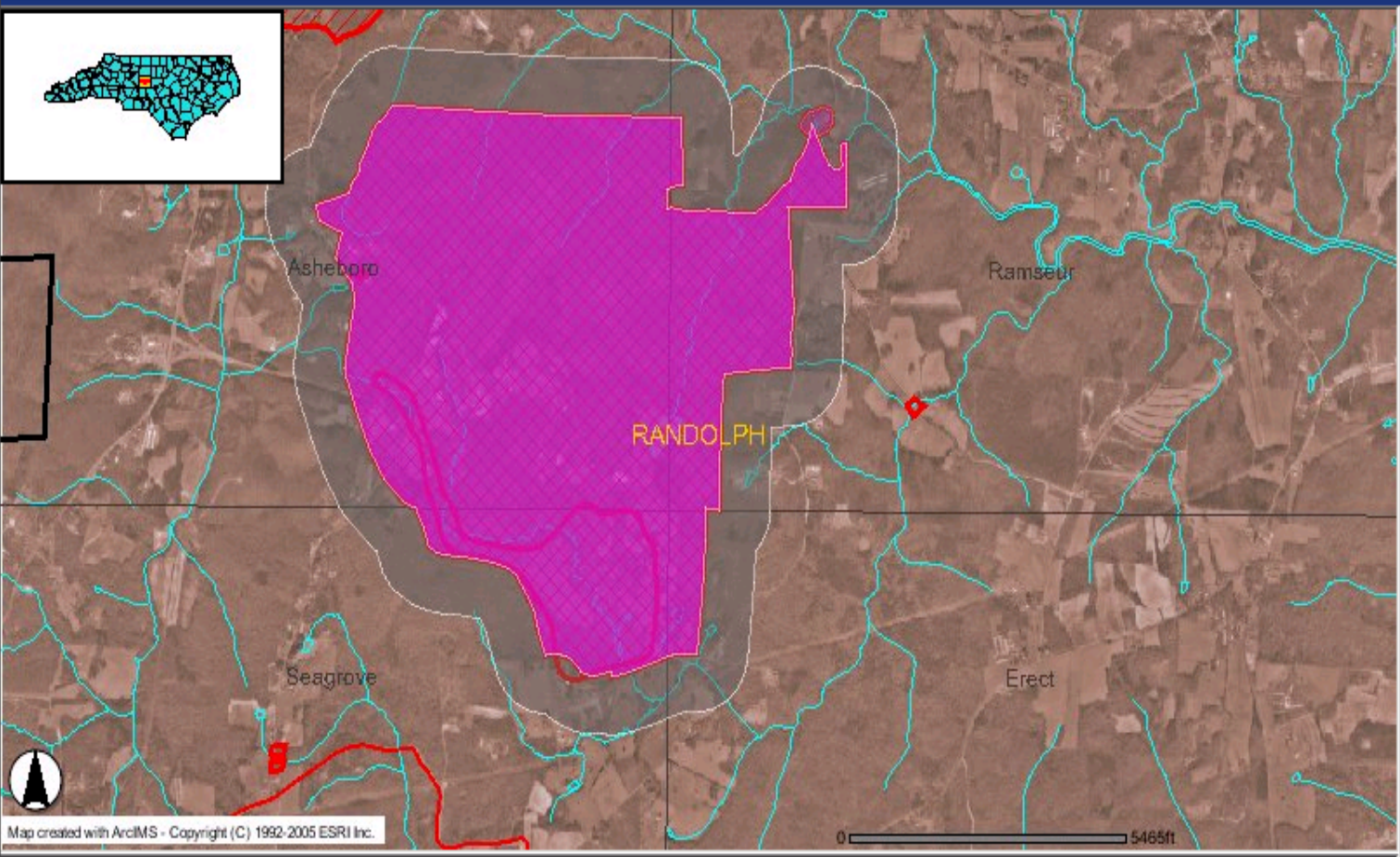

LAYERS

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  - Archaeological Points
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  - Projects Surveyed
    - Project Surveyed
    - Linear Project Survey
    - Recommended For Su
    - Linear Recommended
  - Projects Reviewed
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A map layer.

Recommended For Survey

Rec	ID	FEAT_TYPE	ST_SITE	SITE_ID	ACC	LV	ER	BIB	OTH_NAME	CNTY	PRIM_QUAD	SEC_QUAD	RMS	COMMENT	#SHAPE#	#ID#
1	0	REC_FOR_SURVEY	N/A	N/A	N/A	N/A	ER 01-8189	N/A	N/A	RD	R110	N/A	3		[polygon]	15

Buffer

Affect on Transportation Planning for NCDOT

- Reduced disturbance to cultural resources.
- Increased efficiency (effort and scheduling).
- Modeling archaeological sites to predict impacts early in the planning process (NEPA and Section 106).
- Alternate route analysis.
- Cost savings.

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